INACTIVATION OF BACILLUS SUBTILIS SPORES IN WATER BY A COLD, ATMOSPHERIC-PRESSURE AIR PLASMA MICROJET

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Recently, a few attempts have been reported to inactivate bacteria in aqueous environments. Although effective inactivation of bacteria in their vegetative state (suspended in water) by non-thermal plasmas in or near the water has been reported, few studies have observed effective inactivation of bacterial spores.

In this study, a direct-current, cold plasma microjet (PMJ) with atmospheric air as the working gas, sustained in a quasi-steady gas cavity in water, was used to inactivate *Bacillus subtilis* spores (suspended in water). The PMJ was operated at an air at a flow rate of ~5 slm and a current of 30 mA. The overall pH and temperature of the liquid were observed to change from 7.5 to a steady-state value of 3.4 and from 25^{o} C to 40^{o} C, respectively. The concentrations of NO_2^-, NO_3^- and H_2O_2 were observed to change from 0 to tens of ppm after a 20 min PMJ treatment. Water (without spore suspension) treated with plasma for 20 min was immediately applied to *B. subtilis* spores to evaluate the effect of long-lived reactive species in water (such as O_3) on the inactivation. Other reactive oxygen species and reactive nitrogen species (ROS/RNS), such as OH•, O_2^-• and $ONOO^-$• were detected by Electron Spin Resonance spectroscopy.

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